PINCHIN
LEBLANC
ENVIRONMENTAL

PHASE 1 REPORT
ASBESTOS-CONTAINING VERMICULITE
CAPE BRETON PUBLIC HOUSING

Prepared for:

Nova Scotia Department of Transportation and Public Works,
and the
Nova Scotia Department of Community Services

Pinchin LeBlanc Environmental Limited
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EXECUTIVE SUMMARY

Pinchin LeBlanc Environmental Limited (PLEL) has been retained by the Nova Scotia Department of Transportation and Public Works and the Nova Scotia Department of Community Services, to provide consulting services related to asbestos-containing vermiculite insulation in Cape Breton Public Housing. The services relate to the discovery of asbestos-containing vermiculite insulation in housing units located in Whitney Pier and Ashby Terraces in Sydney, Nova Scotia. In response to a Compliance Order from Nova Scotia Environment and Labour, the Cape Breton Island Housing Authority (CBIHA) undertook steps to address the vermiculite issue including retaining the services of Atlantic Indoor Air Audit Co./HEPA Atlantic (Atlantic Indoor).

PLEL's mandate includes several phases of work. The initial component, termed "Phase I" of the assignment, included an audit/review of actions taken to date by CBIHA and their advisors. The PLEL Phase I work included meetings, orientation, a review of existing information, interviews, and PLEL's own site inspection and limited testing program. This report deals with the findings of the Phase I component of the project.

Based on our audit/review, it has been determined that the methods, procedures and materials used for the sealing of attics, furnace exhaust piping and light fixtures meet or exceed federal and provincial standards for this type of work. The methods and procedures developed by both CBIHA and Atlantic Indoor used for the collection and analysis of: a) suspected bulk vermiculite insulation; b) air samples taken to monitor work-related activities during sealing operations and; c) air samples taken inside of residential units to establish background levels, are all appropriate.

In some of the units inspected, residual vermiculite (minor in nature) debris was observed on floors and mechanical equipment (especially in furnace rooms). At the time of our review, this observation was verbally communicated to CBIHA and steps were taken to conduct a further inspection and cleanup of all units.

In order to assess whether vermiculite may have migrated from attic spaces over time, inspections were conducted of items such as behind switch plates and inside heating ductwork. Some vermiculite was observed in these areas. Phase 2 of this review and audit will address this item. Until that time, no work involving the removal of these plates associated with walls enclosing the heating system should be undertaken without proper precautions.

Bulk and dust surface samples obtained from areas where vermiculite debris was observed were analyzed and did not contain either Actinolite or Tremolite asbestos that are associated with the vermiculite insulation present in the housing units.

Chrysotile asbestos was detected in the three surface dust samples collected by PLEL. The significance of the results is discussed in the report. These results should not be misinterpreted

as a risk to human health or the result of the presence of vermiculite. As stated in the report, this is considered normal for background levels of this type of asbestos as this type is naturally occurring and should be expected for this type of sampling.

No Actinolite or Tremolite known to be associated with vermiculite insulation was found in the samples. This is very significant as these results show that no asbestos contamination can be attributed to the presence of vermiculite in the samples tested. Levels detected are more representative of normal background levels in buildings where it is known that asbestos-containing materials are not present. It is important to understand that asbestos fibres can be found, in detectable concentrations, on virtually any surface both inside and outside of buildings. This is a result of the fact that trace levels of airborne asbestos are present in the environment and in outdoor air due to its natural presence in the earth's crust. In addition, asbestos has been widely used historically in the construction of most buildings prior to 1980 and has been shown to contribute to this natural background.

American Society for Testing and Materials (ASTM) standard used to collect the dust samples references ceiling tiles, shelving, electrical components, ductwork, carpets, etc. For the Phase 1 review, PLEL considered it appropriate to conduct this sampling on surfaces referenced in the standard. The surfaces selected had a visible presence of vermiculite insulation and PLEL concentrated on these more obvious surfaces for this review process (Phase 1 report).

PLEL used a semi-aggressive methodology to obtain air samples. In 2 of the 14 samples analyzed by the Transmission Electron Microscopy (TEM) method, one asbestos fibre was found in each. The results are well below recognized occupational exposure limits.

The Phase 1 report concentrated mainly on the buildings themselves and the effect that the asbestos-containing vermiculite insulation has had on them since its application in 1979. The Phase 2 report will now concentrate on the long term implications of managing this insulation to CBIHA, its staff, the tenants and contractors who may have occasion to work in the buildings.

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1.0 INTRODUCTION/BACKGROUND

Pinchin LeBlanc Environmental Limited (PLEL) has been retained by the Nova Scotia Department of Transportation and Public Works and the Nova Scotia Department of Community Services to provide consulting services related to asbestos-containing vermiculite insulation in Cape Breton Public Housing. The services to be provided are specific to asbestos-containing vermiculite insulation confirmed by previous testing to be present within housing units at both the Whitney Pier and Ashby Terraces in Sydney, Nova Scotia.

In summary, the services to be provided include (but are not necessarily limited to):

1. Conducting an audit/review of the processes taken to date and prepare a report with findings and recommendations

2. Development of criteria that can be used to evaluate the Cape Breton units and other units to determine best asbestos abatement strategies for the long term. Provide costs appropriate to asbestos abatement strategies developed.

3. Provide advice on industry-related best practices and procedures for both short and long term management of asbestos-containing materials.

This report will address Item 1 above and will be considered as the "Phase 1" Report. Items 2 and 3 above will be addressed by the Phase 2 Report; the scope of the Phase 2 report will be, in large part, dependent on the results and recommendations of this initial phase.

The Audit/Review that is the subject of this Phase 1 Report included meetings, orientation, a review of existing information, interviews, as well as PLEL's own limited site inspection and testing program.

This audit/review assesses the procedures and processes developed by others to deal with the presence of asbestos-containing vermiculite insulation previously identified within the housing units known as the Whitney Pier and Ashby Terraces located in Sydney, Nova Scotia. The procedures and processes were developed and implemented as a result of a Nova Scotia Department of Environment and Labour (NSDOEL) Occupational Health and Safety Division Compliance Order 940015 issued to the Cape Breton Regional Housing Authority dated April 6, 2006. In summary form, the Compliance Order required that the following be performed:

1. "Work which may disturb insulation must cease at any Cape Breton Island Housing Authority Units until compliance with Orders #940016-02 and 940016-03 and Stop Work Order #940016-01 is withdrawn or cancelled by an officer".

2. "The employer shall ensure that a quantitative assessment of the asbestos contaminated insulation located at Rose Terrace, Sydney is conducted. A person who possesses the knowledge and/or qualifications in determining the volume of asbestos will conduct the assessment. The results of this assessment will be forwarded to this officer upon receipt"

3. The employer shall ensure that a competent person shall conduct an air quality assessment to determine the volume of asbestos fibres per cubic centimetre which may be airborne in the Rose Terrace complex located in Sydney N S. The report of this assessment shall be forwarded to this officer upon receipt"

In response to Compliance Order 940015, the Cape Breton Island Housing Authority (CBIHA) retained the services of Atlantic Indoor Air Audit Co. (Atlantic Indoor), also referred to as HEPA Atlantic located at 130 St. Peters Road, Sydney, Nova Scotia, to assist in satisfying the requirements of the Order. It is understood that the CBIHA initiated steps to ensure compliance with Items 1 and 2 of the Order and that Atlantic Indoor assisted CBIHA in complying with Item 3 of the Order.

2.0 INFORMATION REVIEW

As an initial step, CBIHA was requested to provide information considered necessary for PLEL to conduct the review/audit process. The following information was requested from CBIHA and provided both in hard copy form and through interviews with key CBIHA staff and Atlantic Indoor:

1. Background information on the CBIHA (general in nature);

2. Any criteria used for determining the priority order for conducting vermiculite insulation inspections;

3. Asbestos Management Programs developed specifically for CBIHA regarding asbestos materials;

4. Tenant notification letters;

5. Procedures developed for sealing of units;

6. Procedures for inspection of units;

7. Copies of NSDOEL Compliance Orders; and

8. Copies of all test results, air samples and bulk samples as well as any specific collection methods used.

PLEL reviewed all the information provided. Although all the information obtained is considered important for the review/audit process, Items 3. 5., 6., 7., and 8. above were considered more relevant for the completion of this Phase 1 component.

These items are discussed in detail below.

2.1 Asbestos Management Programs (AMP) developed specifically for CBIHA regarding asbestos materials (Item 3.)

PLEL was provided with a document entitled "Asbestos Management Program Procedure *Interim*" (Atlantic Indoor AMP). This document is provided in 3 sections:

Section 1	Reasons for Procedures
Section 2	Procedures
Section 3	Work Procedures
Section 3.1	Procedures for Sealing and Cleaning of Structure
Section 3.2	Procedure for ACM Inspection
Section 3.3	Procedures for Emergency Maintenance Operations

As previously indicated, Sections 3.1 and 3.2 of the document were considered more relevant for the Phase 1 review process.

2.2 Procedures Developed for Sealing of Units (Item 5.)

Section 3.1 of the Atlantic Indoor AMP describes the procedures to be followed for cleaning and sealing operations in furnace rooms and other areas where Asbestos-Containing Materials (ACM) are present. The procedures were reviewed and are considered appropriate for the work described where known or suspected friable asbestos-containing materials are present. These procedures meet and, for the most part, exceed various provincial and federal standards for this type of work.

2.3 Procedures for inspection of Units (Item 6.)

Section 3.2 of the Atlantic Indoor AMP describes the procedures to be followed for inspecting attics, crawl and enclosed spaces as well as procedures to be followed for the collection of samples of building materials. The procedures were reviewed and are considered appropriate for inspecting areas where known or suspected friable asbestos-containing materials are present. These procedures meet and, for the most part, exceed various provincial and federal standards for this type of work.

2.4 Copies of NSDOEL Compliance Orders (Item 7.)

PLEL were provided with a copy of all NSDOEL Compliance Orders issued. PLEL considered this information relevant to developing its own inspection and testing methodology.

2.5 Copies of all test results, air samples and bulk samples as well as any specific collection methods used (Item 8.)

PLEL requested and received the results of various tests conducted by Atlantic Indoor. A review of both the air sampling results and the bulk sample results was conducted for the purposes of assessing the analytical methods used as well as the results of all tests.

2.5.1 Bulk Sample Tests

Reports provided indicate the results of 4 bulk sample analysis (vermiculite insulation) pertaining to the buildings at Whitney and Ashby Terraces.
The summarized report data are as follows:

Report Date:	18 April, 2006
Sample:	1 sample identified as 1 Rose submitted by Atlantic Indoor of vermiculite insulation to Pinchin LeBlanc Environmental Limited and then forwarded to International Asbestos Testing Laboratories (IATL) for analysis
Type:	Analysis Method: EPA 600/R-93/116,
Results:	1.6% Actinolite asbestos detected

Report Date:	28 April, 2006
Sample:	2 samples of vermiculite insulation submitted by Atlantic Indoor Pinchin LeBlanc Environmental Limited: • 1 sample identified as Sample #1 collected on April 11 2006, Whitney Pier Building 250 of attic insulation • 1 sample identified as Sample #2 collected on April 11 2006, Ashby Building 350 of attic insulation
Type:	Analysis Method: EPA 600/R-93/116
Results:	Samples #1 and #2 confirmed the presence of Actinolite asbestos

Both labs (IATL and Pinchin LeBlanc Environmental) confirmed the presence of asbestos within the vermiculite insulation. The analytical method referenced is used to identify both the presence and amount of asbestos in materials and is acceptable for the screening and initial identification of asbestos in vermiculite insulation. It is well recognized that results can vary and produce ranges from <0.5% to 5% asbestos by

volume. There are several factors that can produce these varying results such as the amount of material collected, method of collection, the number of samples collected as well as the location where the sample was collected.

2.5.2 Air Monitoring Tests

A total of 30 air samples specific to the Ashby and Whitney Pier Terraces were collected by Atlantic Indoor. The samples were collected during the period between April 17, 2006 and May 12, 2006. The samples were submitted by Atlantic Indoor to Pinchin LeBlanc Environmental Limited and then forwarded to IATL for analysis. The samples were analyzed by the Transmission Electron Microscopy NIOSH: 7402 (Issue 2) analytical method. This method is both qualitative (to identify asbestos type) and quantitative (to indicate amount of asbestos present).

Samples were identified as follows:

1. Inside Samples: samples taken within enclosures where workers were conducting work associated with the sealing of access hatches.

2. Outside Samples: samples adjacent or next to enclosures where workers were conducting work associated with the sealing of access hatches.

3. Tenant Areas: samples taken in a tenant-occupied unit before and after the sealing of access hatches.

4. Undefined: samples collected within various units and apartments of both Ashby and Whitney Pier Terraces.

One sample taken within a worker enclosure or containment work area at 8 Dahlia detected the presence of a single fibre of Actinolite asbestos. The identification of this type of asbestos under the conditions for which monitoring was conducted (within an enclosure during sealing activities) would be considered normal for the work in progress.

The remaining samples were NFD or No Fibres Detected.

3.0 PLEL INSPECTION/TESTING PROGRAM

After reviewing all information provided, PLEL established the criteria that would be used for the remainder of the Phase 1 process. The following criteria were established. As previously indicated, these criteria were based on information provided that all the units within these two housing complexes had asbestos-containing vermiculite insulation in the attics:

1. Select a representative number of units that have been identified with asbestos-containing vermiculite insulation;

2. Determine the type of construction;

3. Inspect previous or completed sealing (attics, etc.) operations; and

4. Conduct sampling/analysis in randomly selected units.

This section provides the details and findings of PLEL's work under these 4 headings.

3.1 Housing Unit Selection

It was indicated by CBIHA that all sealing work (attic hatches, etc.) for each of the units within both the Ashby and Pier Terraces was completed.

CBIHA was requested to provide a list of units available for inspection and testing purposes. It was requested that a list of both typical occupied and non-occupied units be provided. For this portion of the review (Phase 1 Report), it was PLEL's preference to have a greater number of unoccupied units mainly due to the tests and inspections that would be carried out by PLEL personnel. A more detailed description on the test and inspection program is provided in section 3.2 below. CBIHA provided the following list of units:

Ashby Terraces

1 Rose:	unoccupied
7 Lilac:	unoccupied
4 Lily:	unoccupied
14 Tulip:	unoccupied
10 Dahlia:	unoccupied
8 Dahlia:	unoccupied
2 Dahlia:	unoccupied
350 Ashby:	occupied Apartment

Whitney Pier Terraces

21 May:	unoccupied
31 May:	unoccupied
5 May:	occupied
3 May:	occupied
250 James:	occupied Apartment

3.2 Construction Details (Type of Construction)

CBIHA was requested to provide information on the construction of both the Whitney Pier and Ashby Terraces. Construction detail drawings dated 1968 (the date of the construction of the buildings) were provided for the Terraces. No drawings were available for the 2 Apartment buildings.

The drawings would be reviewed by the PLEL project engineer and the Senior Project Consultant for the purposes of understanding the type of construction.

3.3 Sealing Operations in Units (Attic Hatches etc.)

The units selected would be inspected for the purposes of reviewing the sealing operations performed to seal up access points to areas (such as the attics) where it was reported that there is a presence of asbestos-containing vermiculite insulation. PLEL were advised that this insulation was put into the attic areas only and not intentionally placed in any other areas or parts of the units.

PLEL were further advised that sealing also occurred around ceiling-mounted light fixtures and where floors or ceilings did not tightly abut or come up tightly to walls. Additional sealing also occurred at the underside of the first floor where the exhaust duct from the furnace extended up through the floors to the attic then through the roof.

PLEL's inspection also included a general review of cleanliness of the units with particular emphasis placed on the visual observation of vermiculite insulation on various surfaces including inside furnaces, around furnaces on floor, inside duct work where access without major disturbance or demolition could be made.

For this Phase 1 review/audit process, PLEL did not remove access hatches to inspect conditions within the attic spaces themselves.

3.4 PLEL Testing Program

3.4.1 Air Sampling

PLEL would select a minimum of 4 units for air testing. A total of 4 tests per unit would be conducted: 1 test would be conducted outside of the units for background purposes and one test on each of the 3 floors would also be conducted.

Unoccupied units were selected: 2 at Ashby Terraces and 2 at Whitney Pier Terraces. Samples would be collected using calibrated high volume pumps running for a minimum of 4 hours each and all operating at the same time. PLEL felt it prudent to select unoccupied units, as the testing would be done under semi-aggressive conditions that were considered to be representative of occupant activities such as:

- sweeping of floor surfaces (all floors);
- walking up and down stairs;
- bumping against walls, particularly walls enclosing air handling duct work;
- jumping up and down on floors; and
- during the operation of the furnace air blower system

The samples would be sent to the laboratory (IATL) for Transmission Electron Microscopy (TEM) analysis using the NIOSH: 7402 Method.

PLEL did not consider monitoring worker related activities for this Phase 1 review. This type of testing was previously conducted by Atlantic Indoor Co. during sealing operations.

3.4.2 Bulk Sample Testing

PLEL would collect bulk samples of visible dust and/or debris. This would be of material that would be found on floor surfaces, or on other surfaces such as ductwork or mechanical equipment. A total of 3 samples would be collected and submitted to IATL Laboratories for TEM analysis.

3.4.3 Surface Sampling

Surface dust sampling, more commonly referred to as Microvacuum sampling, would be conducted mainly for the purposes of determining if Actinolite or Tremolite asbestos exists within settled dust. This type of sampling is not done for the purposes of determining an exposure level; it is done more to determine a cleanliness level. PLEL does not recommend the use of settled dust sampling in buildings as a hazard assessment tool. This is partially due to the fact that dust testing has been shown not to correlate with airborne asbestos fibre concentration. An equally important reason is that results obtained by Microvacuuming or wipe testing of dust are very difficult to understand, explain and compare to normal background. In considering the drawbacks of dust testing the following quote from American Society for Testing and Materials (ASTM) Method D5755/95 under "Significance and Use of the Method, Section 5" includes these limitations:

> "5.1.1. The test method does not describe procedures or techniques required to evaluate the safety or habitability of buildings with asbestos-containing materials, or compliance with federal, state, or local regulations or statutes. It is the user's responsibility to make these determinations.
>
> 5.1.2. At present a single direct relationship between asbestos-containing dust and potential human exposure does not exist. Accordingly, the user should consider these data in relationship to other available information in their evaluation.
>
> 5.1.3 This test method uses the definition, settleable particulate material, found in Test Method D 1739 as the definition of dust. This

> definition accepts all particles small enough to pass through a 1 mm (No. 18) screen. Thus a single, large asbestos containing particle(s) (from the large end of the particle size distribution) dispersed during sample preparation may result in anomalously large asbestos concentration results in the TEM analyses of the sample. It is, therefore, recommended that multiple independent samples are secured from the same area, and a minimum of three samples analyzed by the entire procedure."

In light of these limitations and qualifications of the method, dust testing is not routinely used for hazard assessment. However, due to the expected concerns of tenants over asbestos in dust, this type of sampling was conducted and the data assessed.

4.0 DISCUSSIONS OF FINDINGS

The above Section 3.0 provides a description of the criteria for the Phase 1 review/audit. This section presents further comment on, as well as the results of, PLEL's findings.

4.1 Housing Unit Selection

For the Phase 1 review/audit program, PLEL considers the list of units provided by CBIHA to have been representative of the units within both Whitney Pier and Ashby Terraces. There was a good mix in that they represented units in varying degrees of condition and cleanliness (housekeeping). There is an obviously disproportionate amount of unoccupied units compared to occupied units. Had this been a concern to PLEL at the time of requesting a list of units, then we would have made our concerns known. For our purposes it was important to have both. However, for our testing and inspection program (which has been described as semi-aggressive) it was considered more important to have more unoccupied units. This gave us the flexibility to conduct the tests we felt appropriate without causing undo concern or anxiety to building occupants/tenants.

The various tests and inspections were carried out over a 3-day period from May 23 – 25, 2006. The work was performed by Trevor Houweling P.Eng., a Project Engineer with PLEL, Jason Stapleton, Env. Tech./Laboratory Manager with PLEL and Ronald F. LeBlanc, Principal and Senior Project Consultant with PLEL.

Below is a list of the Units inspected and the work performed in each of the units:

Address	Status	Work Items
Ashby Terraces:		
1 Rose:	unoccupied	General inspection/Air and Surface Sampling
7 Lilac:	unoccupied	General inspection/Surface Sampling
4 Lily :	unoccupied	General inspection
14 Tulip:	unoccupied	General inspection
10 Dahlia:	unoccupied	General inspection/Air, Bulk and Surface Sampling
8 Dahlia:	unoccupied	General inspection
2 Dahlia:	unoccupied	General inspection/Dust Sampling
350 Ashby:	occupied Apartment	General inspection
Whitney Pier Terraces:		
21 May:	unoccupied	General inspection/Air Testing
31 May:	unoccupied	General inspection/Air Testing
5 May:	occupied	General inspection/Bulk Sampling
3 May:	occupied	General inspection
250 James:	occupied Apartment	General inspection

4.2 Construction Details and Relationship to Vermiculite Insulation Issue

Below is a reported history of completed and scheduled work on both Ashby and Whitney Pier Terraces:

Date	Item
1968	Original construction
1979	Vermiculite insulation installed in the attic spaces
1985-1992	Kitchens relocated
1988	Pro Vac cleaned all ductwork
1989	Canexel, windows & doors program
1992	Additional phase of window & doors program
1993	Additional phase of window & doors program
1993	Major oil tank replacement
1998	Chimneys reconfigured and certified
2004	Additional chimney work at 27, 29, 31, 33 & 35 May Terrace
2005-2006	Roof replacement

4.2.1 Ashby Terraces and Whitney Pier Terraces , Sydney

Ashby Terraces consists of:

One 3 Storey Apartment Building:	10 Units
One 4 Unit Building:	4 Units
One 5 Unit Building:	5 Units
Three 7 Unit Buildings:	21 Units
One 10 Unit Building:	10 Units

Whitney Terraces consists of:

One 3 Storey Apartment Building:	10 Units
One 7 Unit Building:	7 Units
Three 8 Unit Buildings:	24 Units
One 9 Unit Building:	9 Units

4.2.1.1 Construction Details

The buildings at both Whitney Pier and Ashby Terraces primarily consist of a three-storey structure with cast-in-place concrete slab and reinforced concrete foundation walls. Date of construction was reported to be 1968 (38 years old). The terrain slopes to create a to-grade front elevation to a slightly below grade rear elevation. The exterior walls consist of horizontal vinyl siding attached to a wood sheathed, wood platform-framed wall system (i.e. siding, building paper, sheathing, studding, insulation, vapour barrier, gypsum board). Wood framed canopies with asphalt shingles exist above the main entrances. Windows are fixed and vertically sliding units. An interior support structure (i.e. bearing walls) supports the wooden floor joists and deck. Interior walls are wood stud framed and mason block fire separation walls. A gable style pitched wood truss system supports the wooden deck and asphalt shingle roof. Drainage for the roof is provided by sloped to perimeter eaves trough with down spouts discharging at the base of the foundation wall. Penetrations through the roof are vents and metal chimneys. Interior finishes consist of painted gypsum and mason block walls; painted concrete and resilient floor coverings; and painted gypsum ceilings with attic hatches on the upper floors. Metal heating ducts exist where oil-fired furnaces are the primary source of heat. Heating ducts extend through the units through drywall enclosures from the furnaces, which are located on the lowest level. Hydronic baseboard heating is present in the apartment buildings with oil-fired boilers. Kitchen and bathroom exhausts are vented through the exterior wall.

4.2.2 PLEL Inspection of Both Ashby and Whitney Pier Terraces

The construction details of the units were reviewed for the purposes of determining the potential for migration or spread of the vermiculite insulation from the attics to other parts

of the building(s). A visual inspection confirmed the presence of vermiculite insulation on floor surfaces of some of the units, mostly at the lower level and mostly in the Furnace rooms. Some minor amounts were observed inside of some cabinets mainly on lower levels where the old kitchens were located. Visually, to a much lesser extent vermiculite insulation was found on surfaces such as exposed ductwork in furnace rooms and in some cases inside furnaces on the burner mechanisms. Random inspections of ductwork detected visible pieces of vermiculite insulation when grills or diffusers were removed; again this was mostly observed on the lower level where the grills are at the floor level. Visible vermiculite insulation was also observed inside of electrical plug and switch plates where these were associated with walls and bulkheads enclosing the heating ventilation ductwork. None of the visual observations would be considered to be major amounts of the vermiculite insulation; it varied from none to pieces or flecks of vermiculite. Surface and bulk samples were collected in several areas where there was more than a very minor amount of vermiculite insulation observed, the purpose of the sampling was to determine if asbestos known to be associated with the vermiculite insulation was present along with the vermiculite.

Our inspection, although not considered destructive by any means, indicates to us that any migration of vermiculite from the attic to other parts of the building would have been through the heating system enclosures. It was reported that ductwork associated with the heating system was cleaned in 1988. It was further indicated that furnace exhaust flues were replaced in 1998. When the insulation was installed in 1979, it is likely that some migration took place because it was reported that the exhaust pipe opening in the attic is not tightly sealed at the attic floor and some insulation likely would have fallen into the opening down into any openings. Considering that this was or still is the case, when the chimneys were replaced in 1998 this would have likely resulted in disturbance of the insulation in the attics and caused further spread of insulation into the heating system enclosures and down to the basements. It is not expected that any significant further migration or spread of insulation would occur again unless activities of a similar nature or activities directly associated with disturbing attic insulation occurs. During the inspection of some of the ductwork enclosures (by removing grills) it also appeared that the ductwork is not a fully contained system. There were pieces of the sheet metal fastened directly to wood framing and the wood framing itself formed part of the flow of air. Based on this observation it is our opinion that for lower and second floor ceilings where duct work runs adjacent to floor joists air from the system may be forced into ceiling spaces between the joists.

No empty units were available to perform similar testing in the apartment unit however; during our inspection of the 2 apartment units it was apparent that the construction was different than that of the housing units. Since the apartments are heated with hot water (no ductwork) the potential for migration would be significantly less.

4.3 Comments on Sealing Operations in Units

The sealing operations in each of the units were inspected. Each of the units had new covers over the attic hatches. It was reported that original hatches were left in place and that new 20 gauge metal panels secured in place with security/tamper proof screws placed over the original panels. It was indicated that original panels were not disturbed during this sealing operation. Ceiling-mounted light fixtures were caulked around where the fixture(s) meet the ceiling and screws attaching the fixtures to the electrical boxes were covered over with foil tape. In the furnace room, foil tape was applied to wood and furnace exhaust piping to cover or seal in the opening up through to the attic. There were no apparent flaws or defects observed at the time of the inspections. The hatches, caulking and tape appeared to be well adhered and secured.

Asbestos warning signs were placed on most panels. The question was asked why all panels were not marked. It was reported that workers ran out of the warning signs and that CBIHA were awaiting a new supply. PLEL were advised that all sealing operations were performed inside of work area enclosures commonly referred to in the industry as "mini-enclosure systems". Work is done in this manner so as to prevent the spread of dust to other parts of the building.

PLEL removed various electrical plug and switch plates. Plug and switch plates associated with walls that form the enclosures of the heating supply and exhaust systems had varying amounts of visible vermiculite insulation inside of them. This condition was not observed where these plates are on a wall, not associated with the heating systems. Phase 2 of this review and audit will address this item. Until that time, no work involving the removal of plates associated with walls enclosing the heating supply system should be undertaken without proper precautions.

4.4 PLEL Testing Program Results

4.4.1 Air Sampling

PLEL selected 4 units for air testing. A total of 3 tests per unit were conducted. In addition to these twelve tests, 1 additional test at each of the Ashby and Whitney Pier Terraces was collected outside to establish a background level in each area.

Unoccupied units were selected: 2 at Ashby Terraces and 2 at Whitney Pier Terraces. For each Unit, samples were collected using calibrated high volume pumps running for a minimum of 4 hours each and all operating at the same time. PLEL felt it prudent to select unoccupied units, as the testing would be done under semi-aggressive conditions that in our opinion could be representative of occupant activities such as:

- sweeping of floor surfaces (all floors)
- walking up and down stairs

- bumping against or hitting walls, particularly walls enclosing air handling duct work
- jumping up and down on floors,
- and during the operation of the furnace air blower system for sampling period

No attic insulation disturbance activities occurred immediately before the sampling or during the sampling. There were no activities conducted during the sampling that involved the removal of any fixed items such as light fixtures, removal of switch or plug plates etc. or any activities that would be considered routine maintenance or minor renovations.

The samples were sent to the laboratory (IATL) for Transmission Electron Microscopy (TEM) analysis using the NIOSH: 7402 Method.

The sample results are as follows:

Sample Number	Location	Type	Result
6358-T01	1 Rose Terrace	Outdoors	None Detected
6358-T02	1 Rose Terrace	2nd Floor	None Detected
6358-T03	**1 Rose Terrace**	**1st Floor**	**Tremolite Asbestos**
6358-T04	1 Rose Terrace	Furnace Room	None Detected
6358-T05	10 Dahlia Terrace	Furnace Rom	None Detected
6358-T06	10 Dahlia Terrace	1st Floor	None Detected
6358-T07	**10 Dahlia Terrace**	**2nd Floor**	**Chrysotile Asbestos**
6358-T08	21 May Terrace	Furnace Room	None Detected
6358-T09	21 May Terrace	1st Floor	None Detected
6358-T010	21 May Terrace	2nd Floor	None Detected
6358-T011	31 May Terrace	Outdoors	None Detected
6358-T012	31 May Terrace	Furnace Room	None Detected
6358-T013	31 May Terrace	1st Floor	None Detected
6358-T014	31 May Terrace	2nd Floor	None Detected

Our interpretation of the 2 positive results is provided below as follows:

One Tremolite asbestos fibre was detected in Sample #6358-TO3. The fibre was reported as being less than 5 microns in length. Most worker exposure standards concerning permissible occupational exposure are expressed in terms of those fibres having lengths exceeding 5 microns. There is a general, although not universal, agreement that shorter fibres pose far lower hazard to health than long fibres. Since the analytical method used has reported fibres of all lengths this method tends to show more fibres than would be present if only the regulated lengths (>5 microns) were counted and reported. There is currently no regulated level for non-occupational exposure for general occupants of a building. However we will compare the results of Sample #6358-T03 to the current occupational exposure limit for fibres longer than 5 microns. The current occupational exposure limit under the ACGIH standards is 0.1 fibres per cubic centimetre of air; the level reported for this sample is 0.0026 fibres per cubic centimetre of air.

One Chrysotile asbestos fibre was detected in Sample 6358-T07 from 10 Dahlia Terrace. The fibre was reported as being greater than 5 microns in length. Most worker exposure standards concerning permissible occupational exposure are expressed in terms of those fibres having lengths exceeding 5 microns. There is a general, although not universal, agreement that shorter fibres pose far lower hazard to health than long fibres. Since the analytical method used has reported fibres of all lengths this method tends to show more fibres than would be present if only regulated lengths were counted and reported. The current occupational exposure limit under the ACGIH standards is 0.1 fibres per cubic centimetre of air; the level reported for this sample is 0.0026 fibres per cubic centimetre of air.

10 Dahlia Terrace was a fairly clean unit and we could not determine or suggest a reason for the identification of this type of asbestos. It should be noted that vermiculite insulation containing amphibole, tremolite or actinolite asbestos was not found in this test. There may be other products within the Unit that could contain this type of asbestos (i.e. drywall compounds, flooring, mechanical insulation) and as a result of past work, which may have disturbed such products this fibre may have resulted from that. The detection of this type of asbestos was most likely the result of the various semi-aggressive activities that PLEL conducted during the testing period. This result can only be considered representative for the period in which the test took place. It cannot and should not be used as an indication of past or future conditions.

4.4.2 Bulk Sampling

PLEL collected 3 samples of visible dust and or debris. This was material that was found on floor surfaces in sufficient quantities that would satisfy the analytical protocols (minimum 2 grams) for analyses. It is important to note that this type of material cannot

be classified as a building material therefore the 1% asbestos by volume rule (should asbestos be found) would not be applicable in this case. Our (PLEL) purpose in deciding to sample this type of material was more to determine if a presence of asbestos existed whether associated with vermiculite or not. The samples collected had visible vermiculite insulation associated with them. The samples were submitted to IATL Laboratories for Transmission Electron Microscopy (TEM) analysis using the EPA 600/R-93/116 method.

The results of the tests are as follows:

Sample Number	Location	Type	Result
6358-D01	5 May Terrace	Furnace Room	No Asbestos
6358-D02*	10 Dahlia Terrace	Old Kitchen	No Asbestos
6358-D02*	10 Dahlia Terrace	Old Kitchen	No Asbestos
6358-D03	1 Rose Terrace	Furnace Room	No Asbestos

* This sample had 2 phases and each had to be analyzed separately

4.4.3 Surface Sampling

As previously indicated, surface dust sampling (more commonly referred to as Microvacuum sampling) would be conducted mainly for the purposes of determining if a presence of Actinolite or Tremolite asbestos known to be associated with this type of vermiculite insulation exists in settled dust. Also as previously discussed, this type of sampling is not done for the purposes of determining an exposure level. Rather, it is done more to determine levels of cleanliness. PLEL does not recommend the use of settled dust sampling in buildings as a hazard assessment tool. This is partially due to the fact that dust testing has been shown not to correlate with airborne asbestos fibre concentration. An equally important reason is that results obtained by microvacuuming or wipe testing of dust are very difficult to understand, explain and compare to normal background. In considering the drawbacks of dust testing the quote from ASTM Method D5755/95 under "Significance and Use of the Method, Section 5" has been discussed in Section 3.2.4.3 of this document. The analytical method reports results in structures per square centimetre (cm^2). The definition of the term structure is "a term that is used to categorize all types of asbestos particles which are recorded during analysis (such as fibres, bundles, clusters, and matrices). Final results of the test are always expressed in asbestos structures per square centimetre". The analytical method requires that the sample must be re-suspended in water with some added chemicals. This process can break up bundles or clumps into separate fibres. Therefore, if the sample collected contains a single chunk of asbestos which would pose little risk of producing airborne fibres, the analytical result may show many thousands or millions of fibres per square centimetre, since it would include each separated fibre in the reported concentration. It

is therefore very important not to rely on a single high result and draw a conclusion related to the overall dust content throughout a building.
Settled dust can exist on many different surfaces in living spaces such as floor surfaces, shelving, tops of lights, bookshelves, tops of ranges, refrigerators, tops of TV's etc. The ASTM standard references ceiling tiles, shelving, electrical components, ductwork, carpets, etc. For this Phase 1 review process, PLEL determined that inside duct work, floor surfaces and mechanical equipment would be the most appropriate surfaces to sample. This was done in order to obtain a worse case scenario; that is to say we intentionally sampled surfaces with visible accumulation of dust and visible pieces of vermiculite insulation. This would give the highest possible result compared to frequently cleaned surfaces such as carpets, desks, furniture, clothes etc. PLEL concentrated on the more obvious surfaces for this review process (Phase 1 report).

Three surface dust samples were collected and submitted to the IATL Laboratory for analyses using the ASTM D5755/95 method. The sample results are as follows:

Sample Number	Location	Result	Asbestos
6358-MV01	2 Dahlia, 2nd floor Floor Surface	57000 Structures/cm^2	Chrysotile
6358-MV02	10 Dahlia, Furnace Burner Surface	13000 Structures/cm^2	Chrysotile
6358-MV03	7 Lilac, 2nd Floor Ductwork	160000 Structures/cm^2	Chrysotile

The type of asbestos identified in each of the samples was Chrysotile asbestos. No Actinolite or Tremolite known to be associated with vermiculite insulation was found in the samples. This is very significant as these results show that no asbestos contamination can be attributed to the presence of vermiculite in the samples tested. Levels detected above are more representative of normal background levels in buildings where it is known that asbestos-containing materials are not present. It is important to understand that asbestos fibres can be found, in detectable concentrations, on virtually any surface both inside and outside of buildings. This is a result of the fact that trace levels of airborne asbestos are present in the environment and in outdoor air due to its natural presence in the earth's crust. In addition, asbestos has been widely used historically in the construction of most buildings prior to 1980 and has been shown to contribute to this natural background.

Although no contamination is due to the vermiculite, PLEL will provide some interpretation of the Chrysotile asbestos results to address possible occupant concerns. Although the results may seem high, levels detected above are quite typical of normal

background levels in outdoor dust or dust in buildings with no known surfacing materials containing asbestos.

However, despite the common presence of asbestos fibres in settled dust, this does not necessarily imply a risk to human health or even that we are exposed to these asbestos fibres. Asbestos fibres are hazardous to human health mainly when inhaled. Air sampling has shown that the airborne asbestos levels in buildings with sprayed asbestos and settled asbestos dust and debris are no higher than outdoor levels, unless the asbestos or asbestos debris is being disturbed at the time or has recently been disturbed. Published research has shown that airborne levels in buildings are not elevated even when sprayed asbestos or asbestos mechanical insulation are located in a ceiling space that is functioning as an air plenum. This is partially explained by the fact that settled dust containing asbestos fibres is not necessarily capable of re-suspension.

The challenge, therefore, is to establish rational criteria for determining conditions under which the presence of asbestos particles in settled dust constitutes a potential risk to human health. Clearly an actual exposure will only occur at locations where the concentrations of asbestos in the dust are above normal background concentrations. Therefore the dust testing results obtained in any single building must be compared with results obtained from other buildings or sites to be able to conclude if there are significantly elevated concentrations of asbestos in the test buildings. Although only a limited number of tests have been conducted, a study by Ewing, Dawson and Alber[1] provides the most useful comparison. The measured concentrations of asbestos in dust in the Ewing study ranged from none detected up to 140,000 structures in outside dust and from none detected up to 210,000 structures in buildings with no surfacing asbestos-containing materials. The results in buildings with asbestos containing materials are significantly higher with ranges anywhere from 7000 structures to 74,000,000 structures depending on the type of asbestos materials present and the locations of these products. Each of the PLEL test results fall into the lower range of the Ewing study results.

It is clear to PLEL that the reported results from the tests taken lead to the following conclusions:

- The average concentration of asbestos measured in the 3 samples is in the range of asbestos concentration measured in normal dust in buildings where no surfacing asbestos is present.

- Each of the 3 samples show results in the normal range (and at the low end) of asbestos concentration measured in normal dust in buildings where no asbestos has been disturbed.

[1] Observations of Settled Asbestos Dust in Buildings: W. M. Ewing, T. A. Dawson and G. P. Alber, EIA Technical Journal, Summer 1996, pp. 13-17

The presence of vermiculite did not contribute to the reported chrysotile levels in the dust.

We have tried to make these conclusions clear and simple. We do not recommend that this type of sampling be done on a routine basis as it can lead to unnecessary concerns due to the difficulty in the interpretation of this type of sampling. No government standard in Canada requires or relies on the results of dust testing to assess an asbestos hazard and there are no regulated standards to compare the measured results to.

Again, our purpose in conducting this type of testing was more to determine a presence of asbestos from the vermiculite insulation, clearly this did not happen.

5.0 SUMMARY OF FINDINGS

PLEL's review of the requested information from CBIHA leads us to the following conclusions:

1. The methods, procedures and materials used for the sealing of attics, furnace exhaust piping and light fixtures meets or exceeds federal and provincial standard for this type of work.

2. The methods used for both the collection and analysis of suspected bulk vermiculite insulation are the appropriate methods required for analysis of this material.

3. The methods used for the collection and analysis of the air samples taken to monitor work related activities during sealing operations exceeded the regulated methods normally required for this type of monitoring.

4. The methods used for the collection and analysis of the air samples taken inside of residential units to establish background levels or to determine if an asbestos presences existed were appropriate methods of this type of monitoring.

PLEL's current work leads us to the following additional conclusions:

5. In some of the units inspected, residual vermiculite (minor in nature) debris was observed on floors and mechanical equipment (especially in furnace rooms). At the time of our review this observation was verbally communicated to CBIHA and steps were immediately taken to conduct a further inspection and cleanup of all units.

6. Redundant/unused sections of round ducts insulated with fibreglass insulation were observed in the furnace room in most units inspected. Visible chunks and pieces of

vermiculite insulation were observed on the fibreglass. CBIHA could consider removal and disposal of unused equipment.

7. Plug and switch plates that are associated with drywall enclosures around the heating supply system had visible vermiculite insulation inside of them in varying amounts. Phase 2 of this review and audit will address this item. Until that time no work involving the removal of these plates should be undertaken without proper precautions.

8. Vermiculite insulation (small pieces and chunks) was observed inside some of the ductwork. A surface dust sample taken where this condition was observed did not detect either Actinolite or Tremolite asbestos associated with the vermiculite insulation present in the housing units.

9. Based on 3 tests of dust collected from visibly dusty surfaces of 3 units PLEL found no evidence of amphibole asbestos which may have originated in the vermiculite insulation. Normal background levels of Chrysotile asbestos were detected in each of these samples. The issue of further dust sampling will be discussed in more detail in the Phase 2 report.

Phase I of our assignment has now been completed. As indicated throughout the report, our review concentrated on the procedures developed to both identify and assess asbestos-containing vermiculite insulation within the Ashby and Whitney Pier Terraces. As well, the procedures developed and used to seal in access areas to building attics were reviewed and verified by our own field inspections. PLEL conducted a representative number of field inspections and also performed various tests in a total of 13 of the units.

The results of Phase 1 will guide the next Phase 2 of the project. The Phase 1 report concentrated mainly on the buildings themselves and the effect that the asbestos-containing vermiculite insulation has had on them since its application in 1979. The Phase 2 report will now concentrate on the long term implications of managing this insulation to CBIHA, its staff, the tenants and contractors who may have occasion to work in the buildings.

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